INSTRUCTION MANUAL

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J-OMEGA COMPANY

TYPES 71A AND 72A

DIGITAL Q-METER

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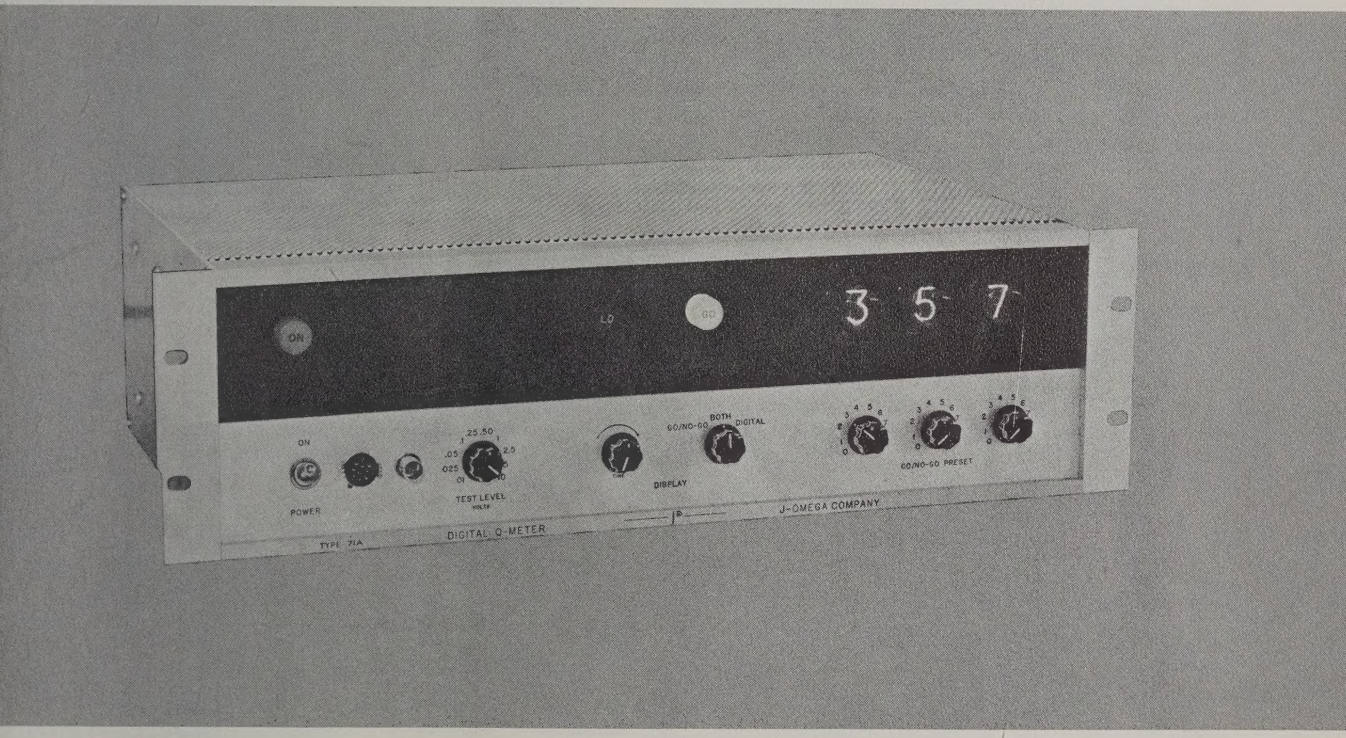
J-OMEGA COMPANY
2271 Mora Drive
Mountain View, Calif. 94040

TYPE 71A DIGITAL Q-METER

For High Speed Production and Inspection



USES

PRODUCTION MONITORING — Toroids, filters, coils, etc., can be rapidly tested for Q value.

TESTING CORES AND CAPACITORS — Q characteristics of capacitors and cores or slugs for inductors may be measured quickly and easily.

QUALITY SORTING — Inductors and cores can be sorted into categories using the preset controls.

PERMANENT RECORDS — Optionally available output code allows digital or analog recording of measurements.

AUTOMATED TESTS — Operating simplicity permits application in fully automated systems.

MANUAL TESTS — Compact bench mounting test jig permits fast, convenient manual testing.

INCOMING INSPECTION — Selectable go/no-go and test voltage features permit quick and versatile setup.

COST REDUCTION — Elimination of the usual retuning procedure and ease of reading greatly reduces measuring time, permits use of unskilled persons.

FEATURES

SIMPLE TO USE — Q-testing requires no repeated operator motions other than connecting the component under test.

FAST — Measurements are made within a fraction of a second.

GO/NO-GO — Preset switches and lights permit application of instrument as a go/no-go test and sorting device.

ACCURATE — Accuracy unaffected by test inductor's distributed capacitance when its capacitance is less than 10% of tuning capacitance.

VERSATILE — Adaptable to semi- or fully automated checkout systems.

SOLID STATE — Compact plug-in card construction with Nuvistor input circuit.

SELECTABLE VOLTAGE — Voltage level for test is adjustable from 10 millivolts to 10 volts.

CODED OUTPUT — Standard modification available to provide 1-2-4-8 BCD output.

DESCRIPTION

The J-Omega Type 71A introduces speed, greater accuracy and the convenience of digital measuring techniques to the area of inductor, capacitor and core Q testing. An entirely new and inherently digital circuit eliminates the local oscillator and thereby obviates manual retuning procedures previously necessary to measure Q. With the 71A no repeated operator motions are required beyond connecting the components to be tested. In addition to its usefulness as a basic measuring instrument, the Digital Q-Meter is ideally suited for use as a production or quality sorting unit. Test go/no-go limits are selectable through a Q range of 0 to 999.

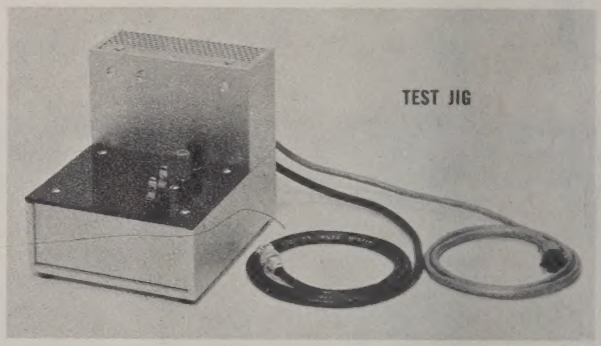
The 71A is supplied with a compact test jig which contains the test terminals and Nuvistor input circuit. The main instrument is fully transistorized and is suitable for rack mounting or bench use. The digital information is displayed by a Nixie readout using long-life tubes.

Coded data in BCD format representing the visual readout and a print command can be supplied as an optional modification. The instrument can then be used to drive a digital recorder, digital-to-analog converter, etc. Because of its inherent capabilities of unattended operation, the J-Omega 71A is well suited for integration into an automated production test setup or for use as a systems checkout unit.

USING THE 71A

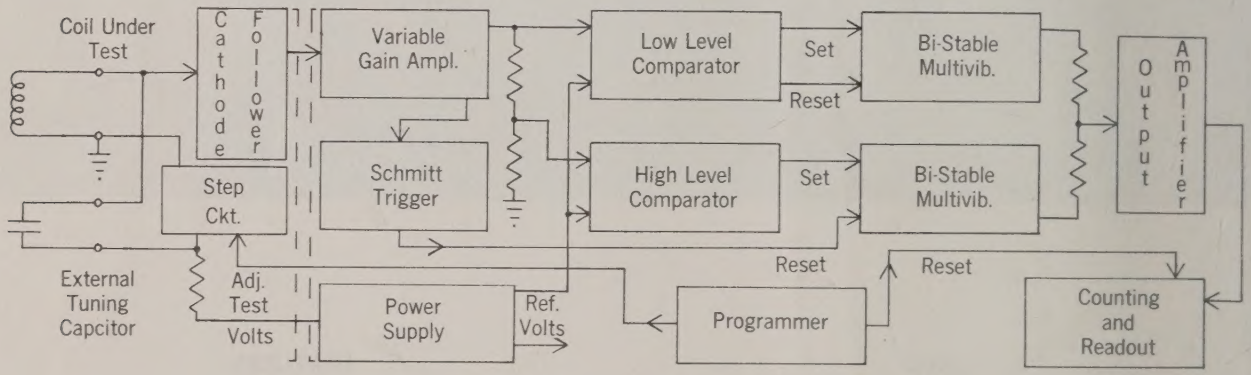
Setting up the Digital Q-Meter is very simple. When preparing for a test run of components, a tuning capacitor is connected to the test jig to tune the inductors to the desired test frequency. Then an appropriate test voltage is selected using the "Test Level" control. The operator now need only insert inductor leads into the test jig contacts to make Q measurements. Q value is automatically displayed within ¼ of a second. The "Display" control allows selection of a convenient readout display time or latching of the readout.

To use the instrument as a go/no-go comparator, the preset switches are positioned to the desired limit value. When testing, one of two indicator lamps will light to indicate whether the particular component being tested has a Q value above or below the pre-selected level. The 71A adds a significant contribution to the absolute accuracy of many Q measurements; readout accuracy is not affected by the internal capacitance of an inductor under test provided its capacitance is less than 10% of the test circuit tuning capacitance.



CIRCUITRY

The adjustable test voltage charges the capacitor of the external resonant circuit containing the coil under test. This circuit rings thereby producing a decaying sinusoidal waveform when the programmer actuates the step circuit. The Schmitt, voltage divider and comparators control the input to the counting circuits so that they register cycles of the decaying waveform occurring between two comparator reference voltage levels. The relative reference levels are pre-determined so that the number of cycles counted equals Q.



SPECIFICATIONS

INDUCTANCE RANGE 10 microhenrys to 1 henry.
FREQUENCY RANGE 10 kc to 1 mc (lower frequency instruments available).
ACCURACY 2% or 1 digit of Q, whichever is greater.
RANGE OF Q 0 to 999.
TEST CIRCUIT TUNING External fixed variable capacitor provided by user.
TEST AMPLITUDE Selectable steps of 10, 25, 50, 100, 250, 500 mv, 1, 2.5, 5, 10 volts.
INSERTION RESISTANCE 5 milliohms (approx.) relay contact resistance in series with resonant circuit; 100 megohm or greater input resistance shunts resonant circuit. Effect on accuracy should be considered when measuring high values of Q with extreme values of reactance ($2\pi fL$).
PRESET RANGE 000 to 999.
RESPONSE .25 second.
DISPLAY TIME Variable .5 to 10 seconds and infinite.
POWER 105 to 125 volts a-c, 50-1000 cps, 35 watts, (220 volts available).
DIMENSIONS 5¼"H x 19"W x 12"D (test jig: 5"H x 5"W x 6"D).
WEIGHT Net 17 lbs. Shipping 27 lbs.
PRICE $2,190.
OPTIONS 1-2-4-8 BCD output. "0" is —15 volts and "1" is 0 volts. $125.

eBG and **eem** buyers' guides list J-Omega representatives. Technical aid, etc., is conveniently available to you from these representatives.

REPRESENTED BY:

J-OMEGA COMPANY
2278 MORA WAY • MOUNTAIN VIEW, CALIF. • (415) 961-2000

SPECIAL NOTE ON TYPE 72A

The text of this manual is written to cover both the Type 71A and Type 72A. The principal specification and operating distinctions of the 72A are:

Frequency Range - 400 Hz to 1 MHz (instead of 10 KHz to 1 MHz).

Test Voltage Range - .10 V to 5 V (instead of 10 mV to 10 V).

Counting Time Selector Switch added on rear panel.

INTRODUCTION

General

The J-Omega Digital Q-Meter is an entirely new kind of Q measuring instrument designed to provide you with a much faster and more convenient way to measure the quality factor of various types of inductors, capacitors and cores. A substantial improvement in the basic accuracy of these measurements is also attained.

The instrument serves both as a measuring tool for absolute Q value measurements and/or as a quality-sorting device where the LO/GO lamps are observed in the testing routine.

The Digital Q-Meter will prove a valuable asset in industry's continuing efforts to increase measurement efficiency and reduce costs.

The Q-Meter is comprised of two units: 1 - the Test Fixture which contains the "test circuit" input terminals plus the primary input circuitry and 2 - the Main Instrument that supplies power to the Test Fixture and contains all other circuitry, controls and the readout.

About Q

The concept of Q, though widely used, is often not well understood. The Q of an inductor is well known to be the ratio of its inductive reactance to its equivalent series resistance (it may also be stated as the ratio of equivalent shunt resistance to inductive reactance). The picture becomes clouded, however, by many factors. These include the fact that inductive reactance and the equivalent resistances vary with frequency so that a frequency must be specified when a specific value of Q is being considered.

Further conplicating factors arise since inductors are typically used with capacitors and the capacitors will affect the Q of the resulting resonant circuit. In addition, the distributed capacitance of the inductor under test may affect Q reading differently than the external tuning capacitor (this depends upon the nature of the test method).

Finally, very small resistances in the test circuit are likely to have significant effects upon Q, and may contribute to measurement errors.

Because of the many factors involved, it is important to state exactly what the Digital Q-Meter measures and what it does not measure.

1. The instrument does not contain a frequency source. It makes its measurements at the natural frequency of the resonant circuit under test. This circuit consists of the inductor and capacitor which are connected across the terminals of the Test Fixture by the user, together with stray inductance, capacitance and resistance provided by the Test Fixture itself. The fixture's inductance and capacitance will usually be negligible, but its rated series resistance of approximately 5 milliohms may be significant in some measurements.

2. The user may select the test frequency by connecting a capacitor that will tune the inductor under test to the desired frequency.

3. The instrument measures Q only of the fully resonant circuit, not of the inductor alone. If the capacitor's effect is to be avoided, the capacitor itself must have very high Q. High quality polystyrene or mica capacitors should be used for this reason.

4. Likewise, what one usually wants to measure is the Q of an entire resonant circuit, not just of the inductor alone. In this case the capacitor should be the one that is actually going to be used with the inductor, or one that resembles this capacitor as closely as possible.

5. It is important, and not always easy, to know which of the above measurements is actually desired.

6. When the Digital Q-Meter measures the Q of the total resonant circuit, no correction is required for the distributed capacitance of the inductor. (Special provision must be made, however, if the capacitance is greater than about 10% of the total tuning capacitance -- consult the factory about this).

7. The instrument only measures Q -- it is not designed as a high speed, high-accuracy instrument for this specific purpose. It does not provide inductance or resistance data. Here the principle of operation is essentially different from that of other instruments commercially available.

[illegible] frequently be possible to know all of the factors [illegible] above that may affect the accuracy of Q measurements. This is often [illegible] regardless of the type of Q-Meter used. The unit will none[illegible], be a very useful tool, since it can be used for high-speed, [illegible] measurements. All that is needed, of course, is a [illegible] inductor and capacitor having characteristics that are known to be sufficiently [illegible] than the unknown ones. An unknown inductor may then be substituted for the reference unit and Q-Meter's readings [illegible] as an indication of the comparison of the two inductors.

[illegible] not assume that all measurements will be within the instrument's [illegible] accuracy of ±5% or 5 counts. For example, an inductor with [illegible] of 1000 will produce a "Q" [illegible] reading if the capacitor's Q is [illegible] 10,000. This error would be increased to 20% by the fact [illegible] Q's (5 million) are [illegible] inductor's Q could be [illegible] as low as 1) [illegible] the test frequency.

[illegible] operator may not be concerned [illegible] with the use [illegible] [illegible] to the fact that calculation will be necessary before [illegible] can be completely confident [illegible] the accuracy of his Q measurements. Furthermore, this is [illegible] of this type of instrument [illegible] measuring method has [illegible].

power source, note the required nominal
of the instrument. The standard
A-C sources providing 105 to
volt instrument is suitable for use

The Test Fixture has the following controls and features:

Power Switch: [illegible] the front end of the instrument. A "POWER" lamp above the switch lights when power is applied. The Test Fixture should be connected to the Main Instrument before turning on the power.

Cable Connectors: [illegible] The 15-pin multi-pin connector supplies power and programming signals to the Test Fixture. The coaxial BNC connector couples the Q signal input to the Main Instrument.

"TIME" Control: The left ("TIME") knob controls the interval for presentation of digital and LO/GO indications. Minimum display time of about 0.1 second is provided in full CCW position. Turning the knob clockwise increases the display time to a maximum of 10 seconds. The display will be held permanently when the knob is turned further to operate a

"LO", "GO", "HOLD": [illegible]

The three knobs permit selection of a value between 000 and 999 as a limit point for "LO" or "GO" lamp indication. For example, if the number 300 is selected, all measurements with a Q value of 300 or above will give a "GO" indication. Those of 299 or less will indicate "LO".

counting interval. Refer to the

necessary

one

will eliminate or reduce the

if eliminating or moving

is impractical.

is

readout obtained is Q of a resonant

or a capacitor alone. In the Digital

neither the capacitor nor the inductor is built into the

. This gives the user freedom to control both elements of

Q of a complete LC circuit that he wishes

places upon the user the need to determine

that is, the one which is not being tested)

that it will not affect the accuracy of

the majority, this may not be

a "standard" capacitor with a Q of

reading the Q of a coil when is 500.

[illegible] surrounding [illegible] should be [illegible] They are very [illegible] [illegible] [illegible]

[illegible] the signal coming from the Test Fixture so that the [illegible] to the rest of the circuitry will decay from an initi[illegible] approximately [illegible] (higher than 10 mV and). [illegible] measurements, a D-C level is used to [illegible] resonant circuit and the resulting high level exponent[illegible] attenuated after it comes from the Test Fixture. [illegible] measurements are desired, the D-C level is attenuated so [illegible] a low initial amplitude, but little [illegible] signal leaves the Test Fixture. [illegible] always has about 15 mV peak initial [illegible] level coming from the resonant circuit; [illegible] will vary, however, depending on the Q of the resonant [illegible].

[illegible] from the attenuator is now amplified in the Input Amplifier [illegible]. It will decay from an initial amplitude of slightly over 10 volts, [illegible] of the initial amplitude produced for, and coming from the [illegible] circuit.

[illegible] output of the amplifier, the signal is divided into three paths:

1. [illegible] applied directly to the input of "Low Level Comparator" which [illegible] when the positive signal peak drops below 2.22 V; [illegible] "end of count".

2. [illegible] attenuated in the ratio 2.1/1 [illegible] applied to the input of "High Level Comparator" which determines when the attenuated signal's negative peak is no longer more [illegible] than the [illegible] signal is therefore less than 10.14 x 2.1 = 10 V. [illegible] to count for "start of count".

3. The unattenuated signal is also applied to the input of a Schmitt trigger which determines when the signal becomes more positive or negative.

[illegible] "High Level Comparator" [illegible] a bistable "Low Level Multivibrator" [illegible] shapes the pulses from the comparators and gives them a fast rise [illegible].

[illegible] in the "set" condition [illegible] level comparator [illegible] negative, [illegible] by the bistable trigger. [illegible] high level multivibrator

from the two multivibrators and summed in two resistors,
the output amplifier consisting of a single switching
levels
high level comparator not
actuated).
ork which converts from
and drives high voltage readout
ie tubes for visual readout of
reset selector circuits which
is equal to or higher than the
tuates a lamp driver circuit to
ation to a GO lamp indication.
re system is produced by a programmer circuit
g multivibrator which feeds driver transistor
llowing functions:
cuit to initiate a new transient so that a
a new count

[illegible] a short duration pulse (roughly 0.2 sec.)
[illegible] three functions occur, followed by a pulse of
[illegible] which the readout is displayed. Length of this
[illegible] "DISPLAY TIME" control on the front panel.
[illegible]

characteristics. To minimize this

ve been used throughout, in-

A routine calibra-

Such coils should be as

in a controlled environment

the testing should also be care-

These precautions are recommended to

d to the Q-Meter which, in fact, may be

supplied with a pair of adaptors to fit the

n or other Q-standards to the conventional

the Test Fixture.

lip leads, etc.) i

...procedure is as follows:

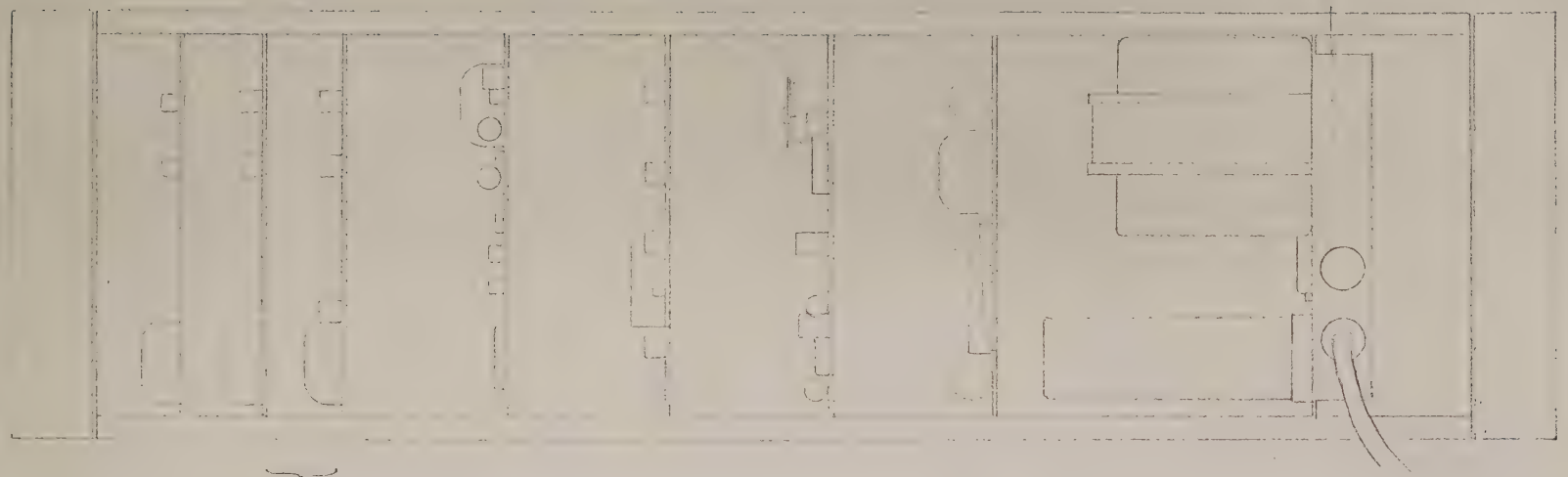
...circuit as described above using 1 MHz Q-standard.

[illegible] at or within [illegible]

[illegible]

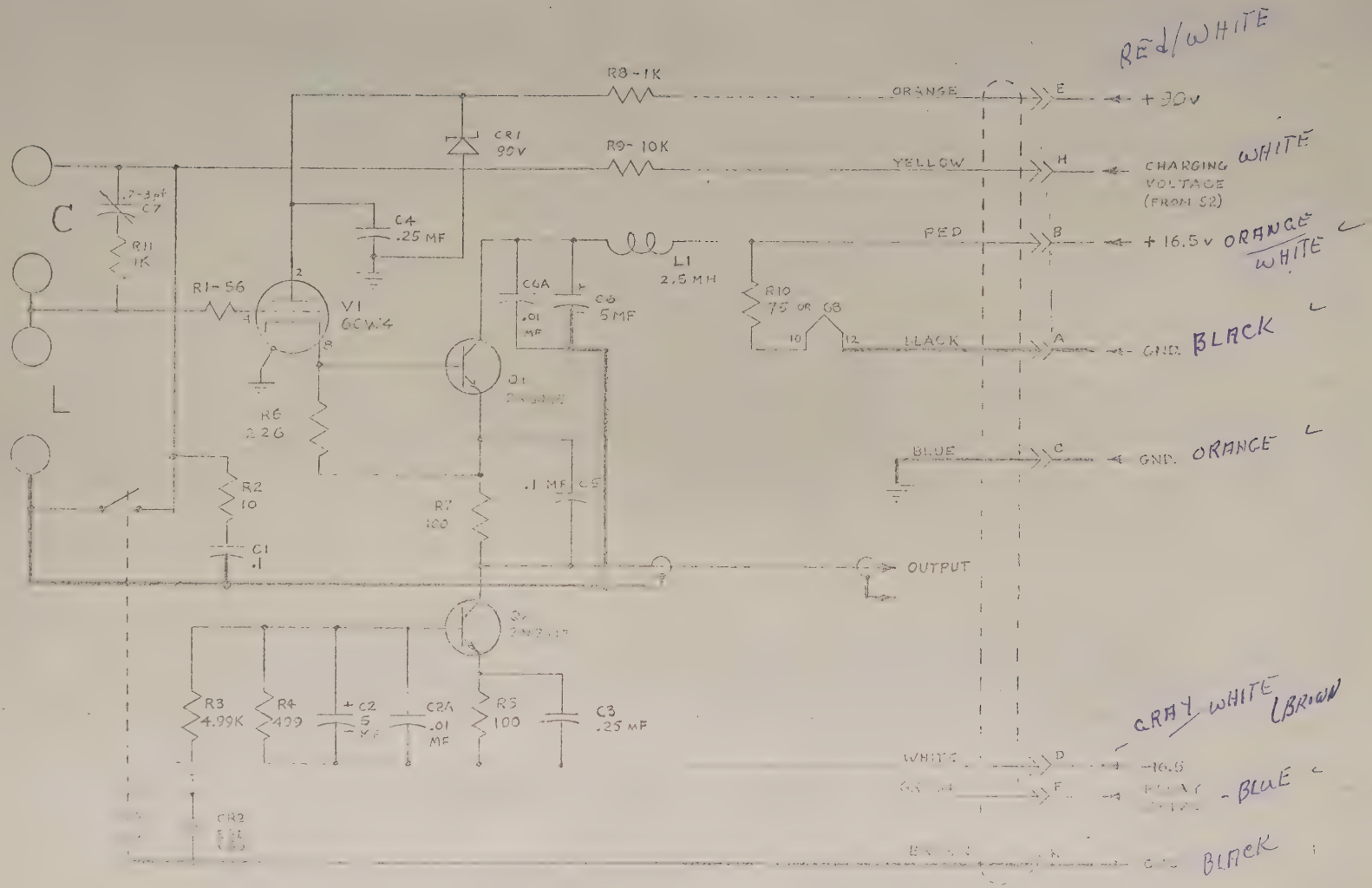
[illegible]

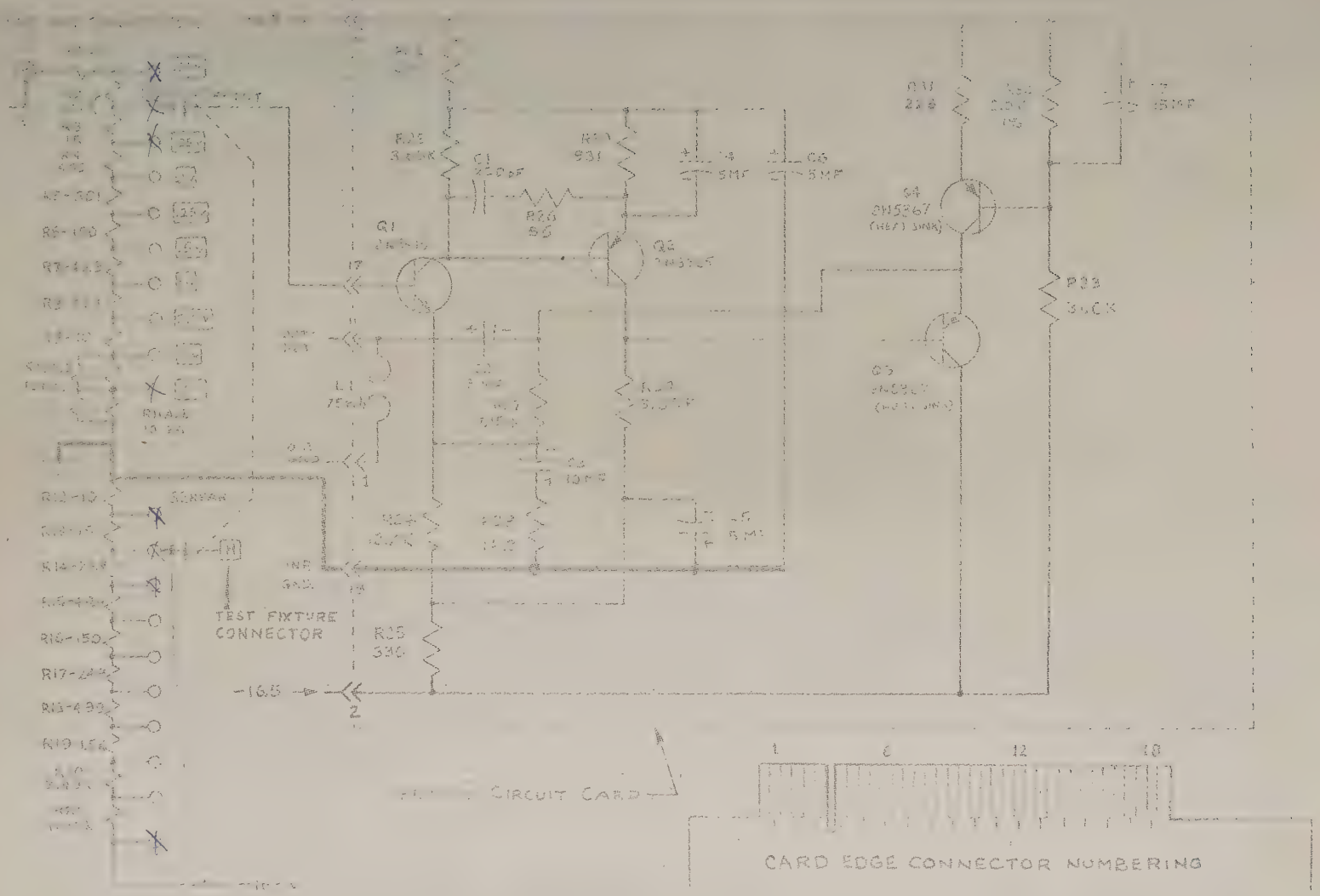
made on a more frequent [illegible] This could involve initially [illegible] coil and capacitor of each [illegible] tested with the Digital [illegible] uction run is to be made, [illegible] the appropriate production [illegible]



REAR VIEW

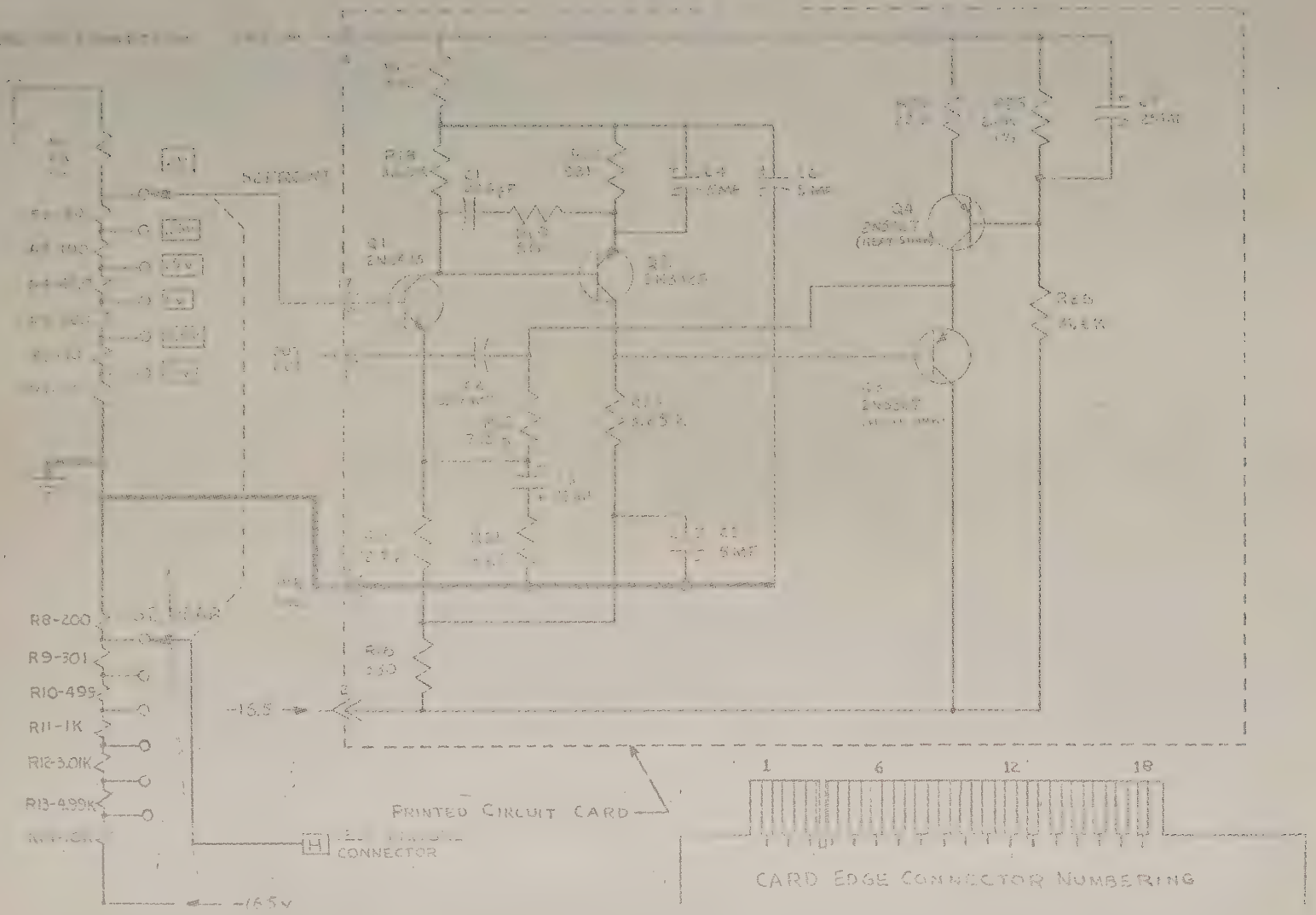
CIRCUIT BOARD


R8-1K
CR1
90V
R9-10K
C4
.25 MF
C7
R11
1K
R1-56
V1
6CW4
C6A
.01
MF
C6
5MF
L1
2.5 MH
R10
75 OR 68
Q1
R6
220
R2
10
C1
.1
.1 MF
C5
R7
100
OUTPUT
Q2
R3
4.99K
R4
499
C2
5
C2A
.01
MF
R5
100
C3
.25 MF
CR2
ORANGE
E
+ 90V
YELLOW
H
CHARGING
VOLTAGE
(FROM S2)
RED
B
+ 16.5 V
BLACK
A
GND.
BLUE
C
GND.
WHITE
D
-16.5
F
K
RED/WHITE
WHITE
ORANGE
WHITE
BLACK
ORANGE
GRAY
WHITE
BROWN
BLUE
BLACK



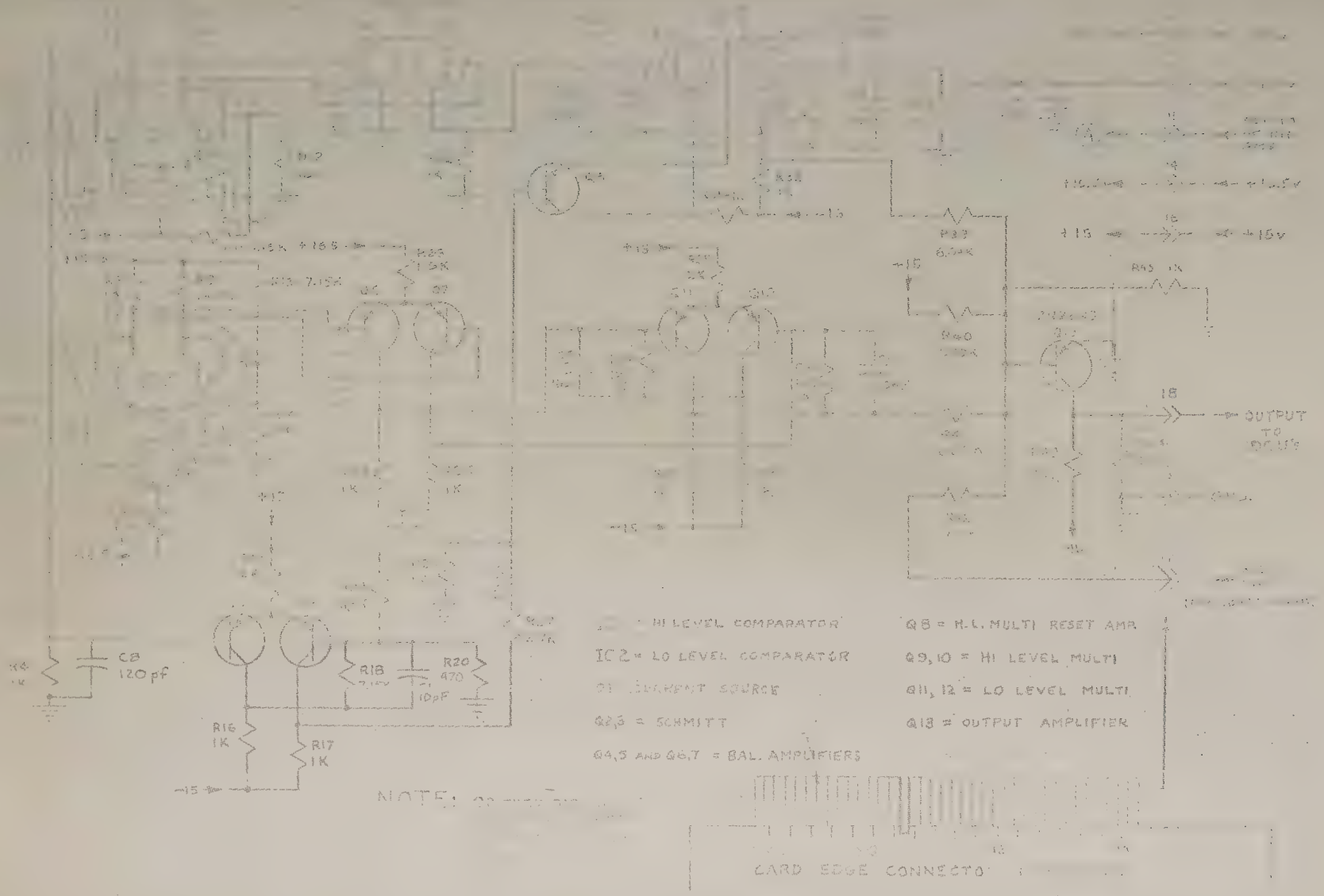
INPUT ATTENUATOR & INPUT AMPLIFIER - 7L5

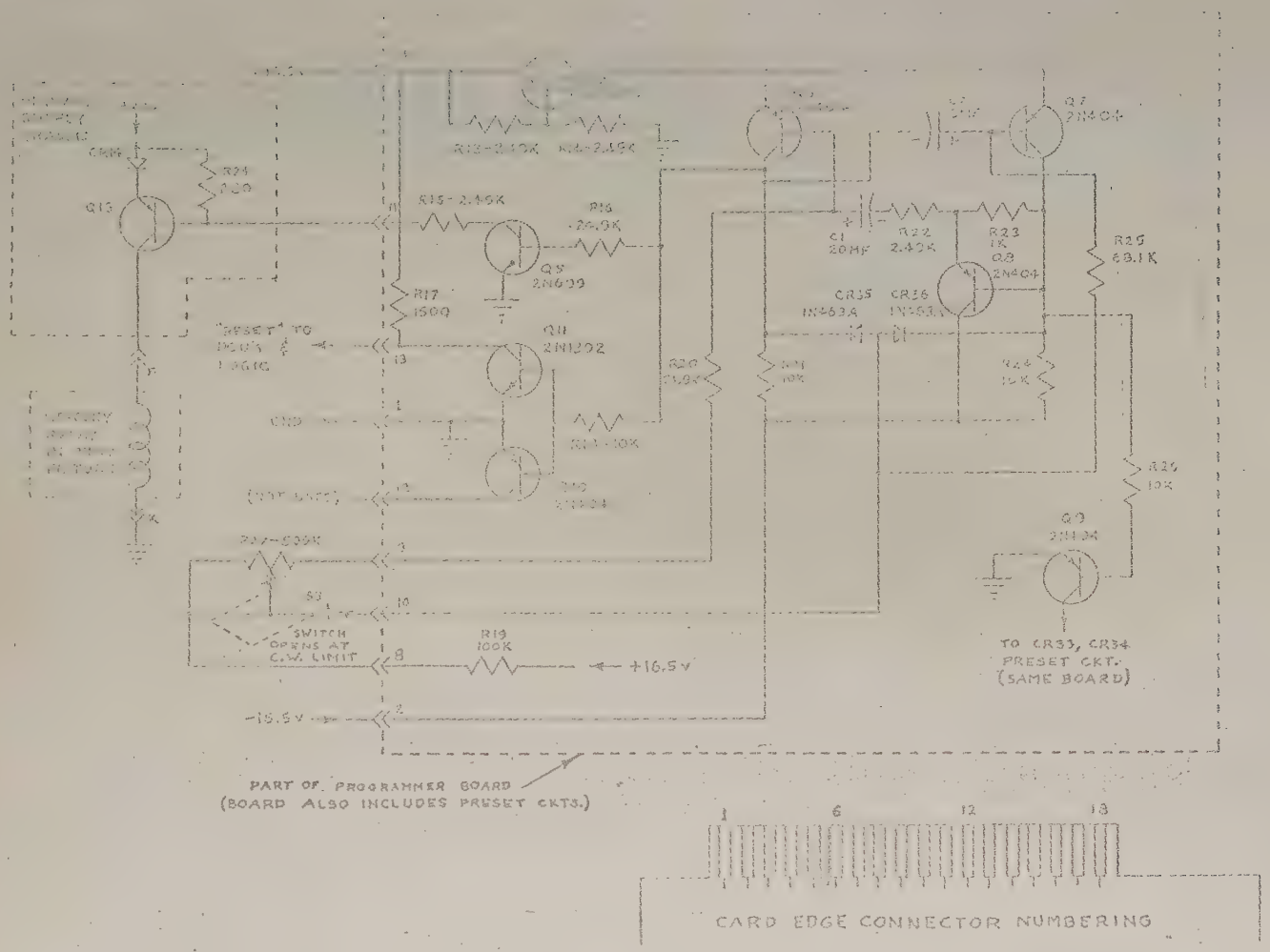
BOARD U36 - ATTEN.
3002

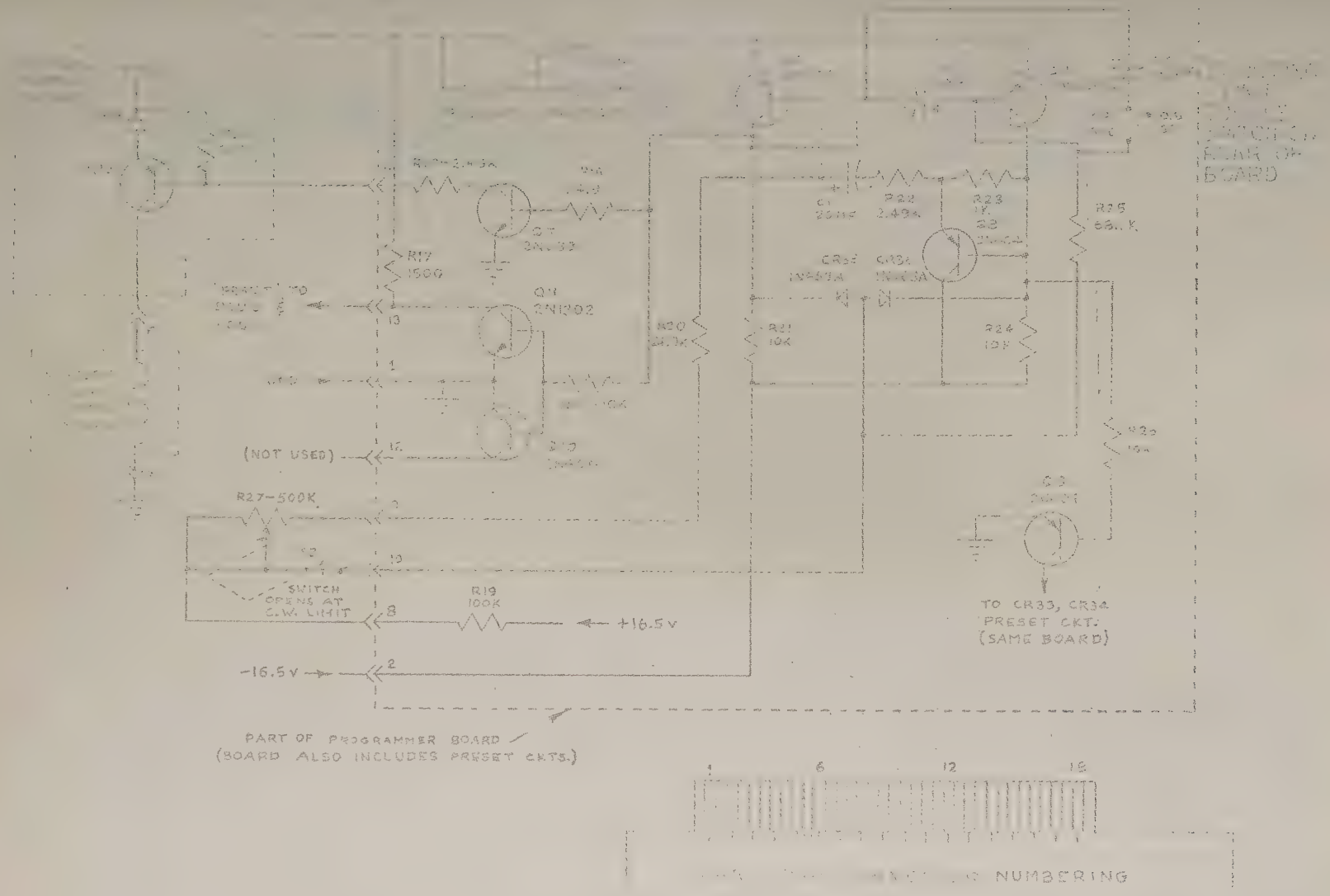


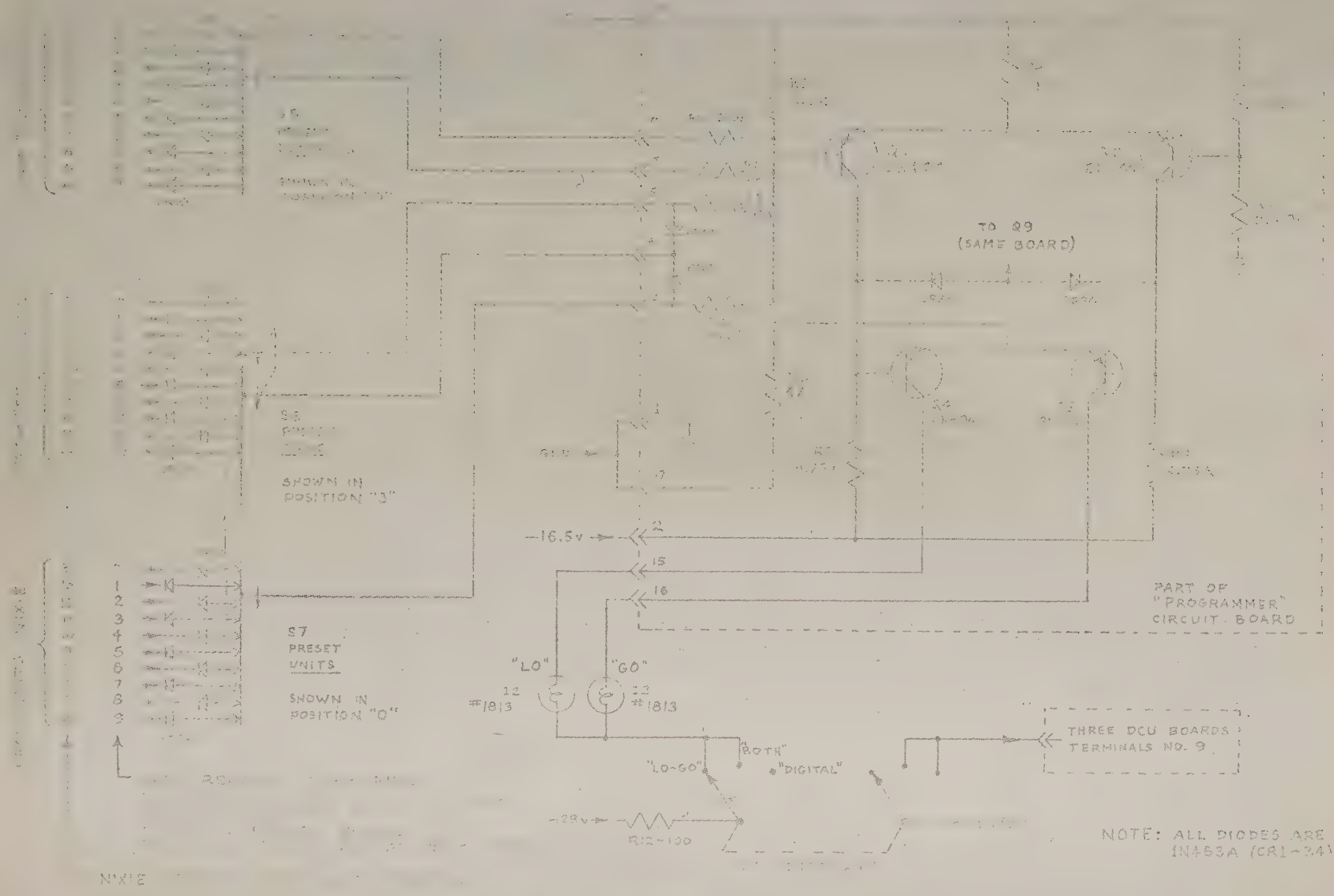
INPUT ATTENUATOR & INPUT AMPLIFIER - 72A

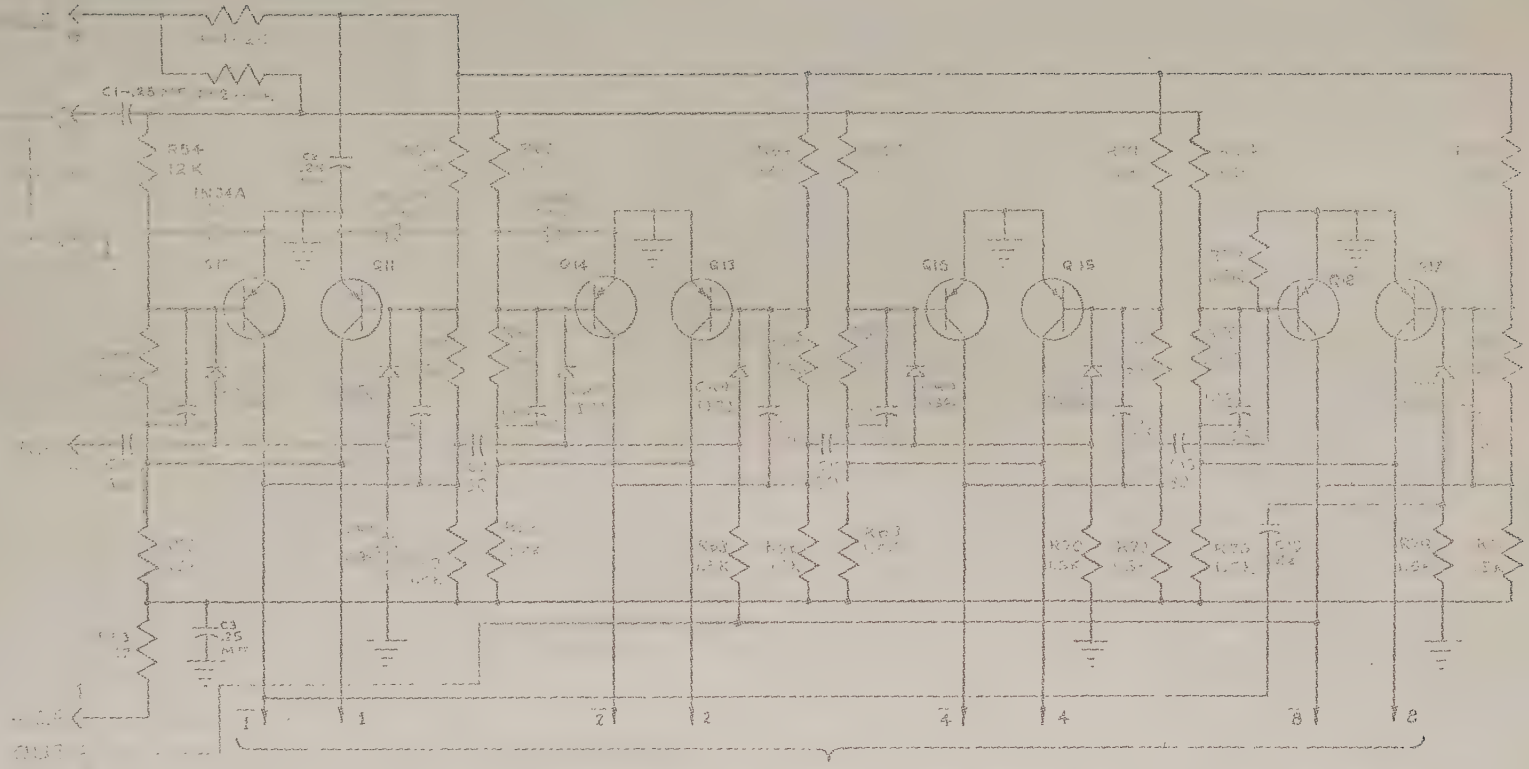
BOARD 1136/2+ATTEN. S002


C8
120 pf
R16
1K
R17
1K
R18
7.15K
R20
470
10pF
-15
+15
OUTPUT
TO
DCU
CARD EDGE CONNECTO
IC 2 = LO LEVEL COMPARATOR
Q8 = H.L. MULTI RESET AMP
Q9,10 = HI LEVEL MULTI
Q11, 12 = LO LEVEL MULTI
Q18 = OUTPUT AMPLIFIER
Q4,5 AND Q6,7 = BAL. AMPLIFIERS

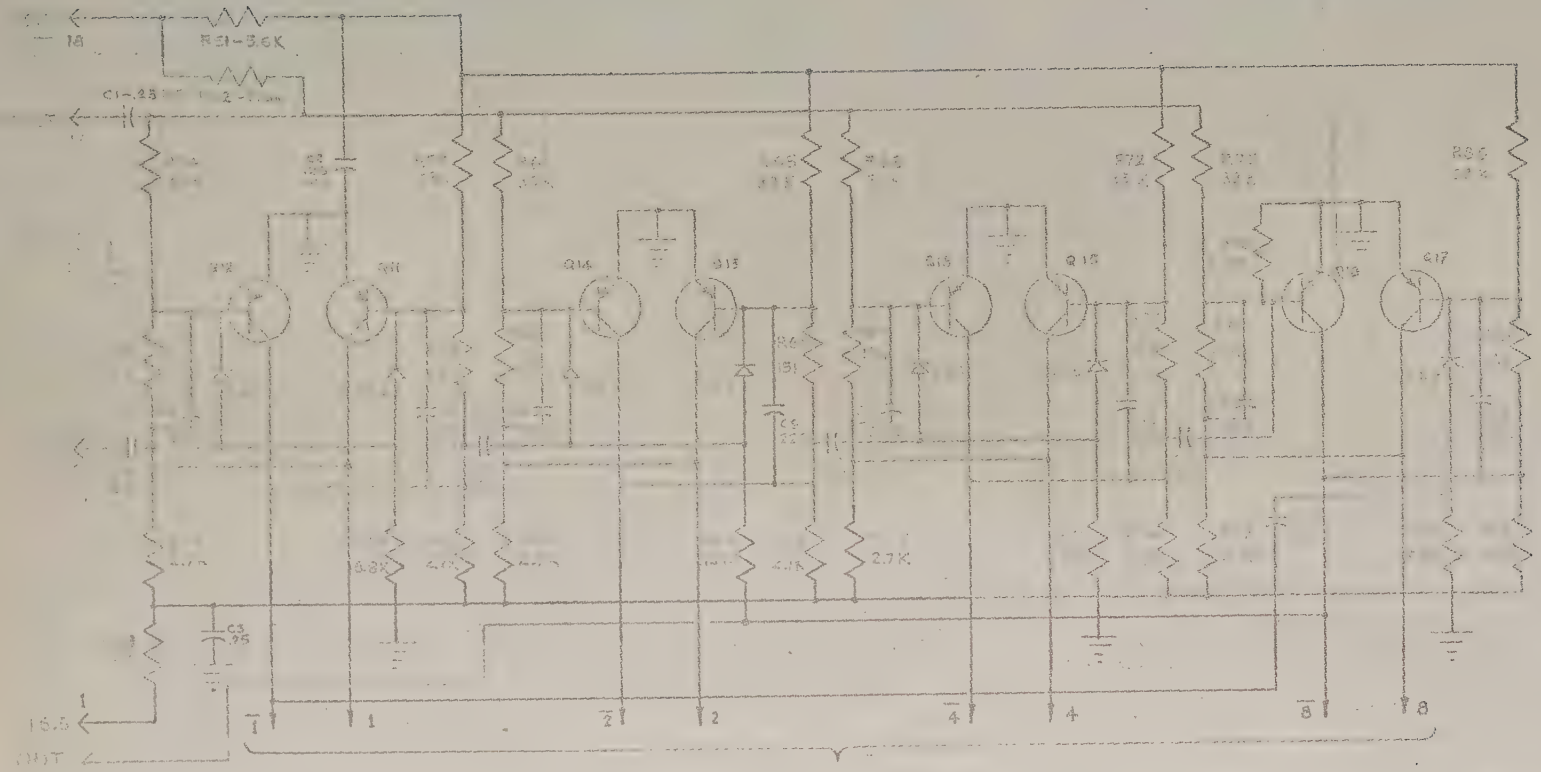

R24 100
Q13
R15 - 2.49K
R16 24.9K
Q5 2N699
R17 1500
"RESET" TO PC U'S & LOGIC
Q11 2N1202
R20 4.99K
R21 10K
R22 2.49K
R23 1K
Q8 2N404
Q7 2N404
R25 68.1K
CR35 IN4634
CR36 IN4634
R24 10K
R26 10K
Q9 2N1634
SW3
SWITCH OPENS AT C.W. LIMIT
R19 100K
+16.5 v
-16.5 v
TO CR33, CR34 PRESET CKT. (SAME BOARD)
PART OF PROGRAMMER BOARD (BOARD ALSO INCLUDES PRESET CKTS.)
1
6
12
18
CARD EDGE CONNECTOR NUMBERING


R17
1500
Q1
2N1302
R20
10K
R21
10K
R22
2.49K
R23
1K
R24
10K
R25
68.1K
R26
10K
C1
20MF
C2
.05 MF
CR32
CR33
CR34
(NOT USED)
R27-500K
SWITCH
OPENS AT
C.W. LIMIT
R19
100K
+16.5 V
-16.5 V
TO CR33, CR34
PRESET CKT.
(SAME BOARD)
PART OF PROGRAMMER BOARD
(BOARD ALSO INCLUDES PRESET CKTS.)
1
6
12
16
NUMBERING


TO 99
(SAME BOARD)
S6
SHOWN IN
POSITION "3"
-16.5v
15
16
S7
PRESET
UNITS
SHOWN IN
POSITION "0"
1
2
3
4
5
6
7
8
9
"LO"
"GO"
12
#1813
13
#1813
"BOTH"
"LO-GO"
"DIGITAL"
PART OF
"PROGRAMMER"
CIRCUIT BOARD
THREE DCU BOARDS
TERMINALS NO. 9
-28v
R12-130
NOTE: ALL DIODES ARE
IN463A (CR1-34)
NIXIE

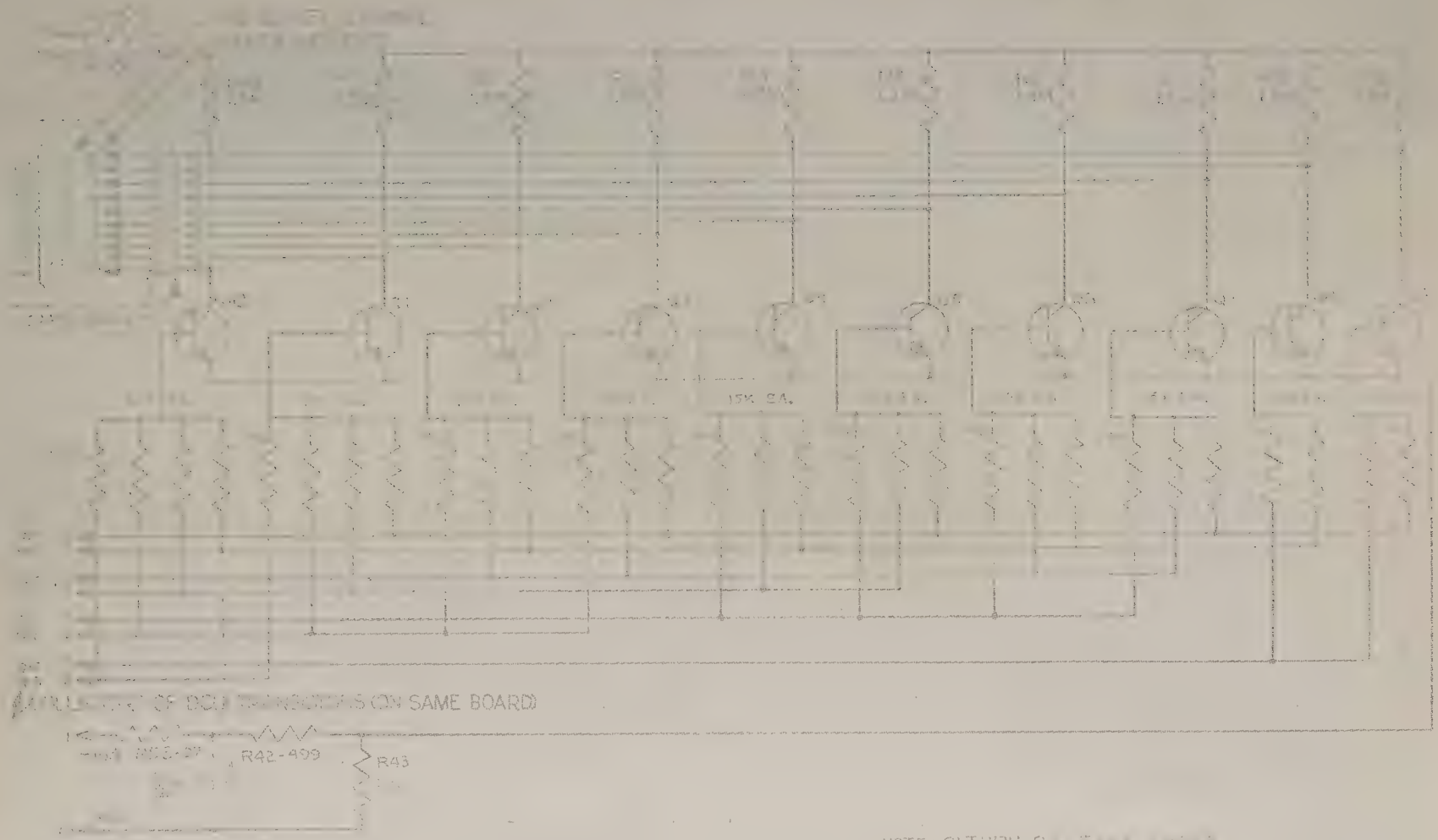


BCD OUTPUT TO READOUT TUBE DRIVER CKT.
ON SAME CKT. BOARD



BCD OUTPUT TO READOUT TUBE DRIVER CKT.
ON SAME CKT. BOARD

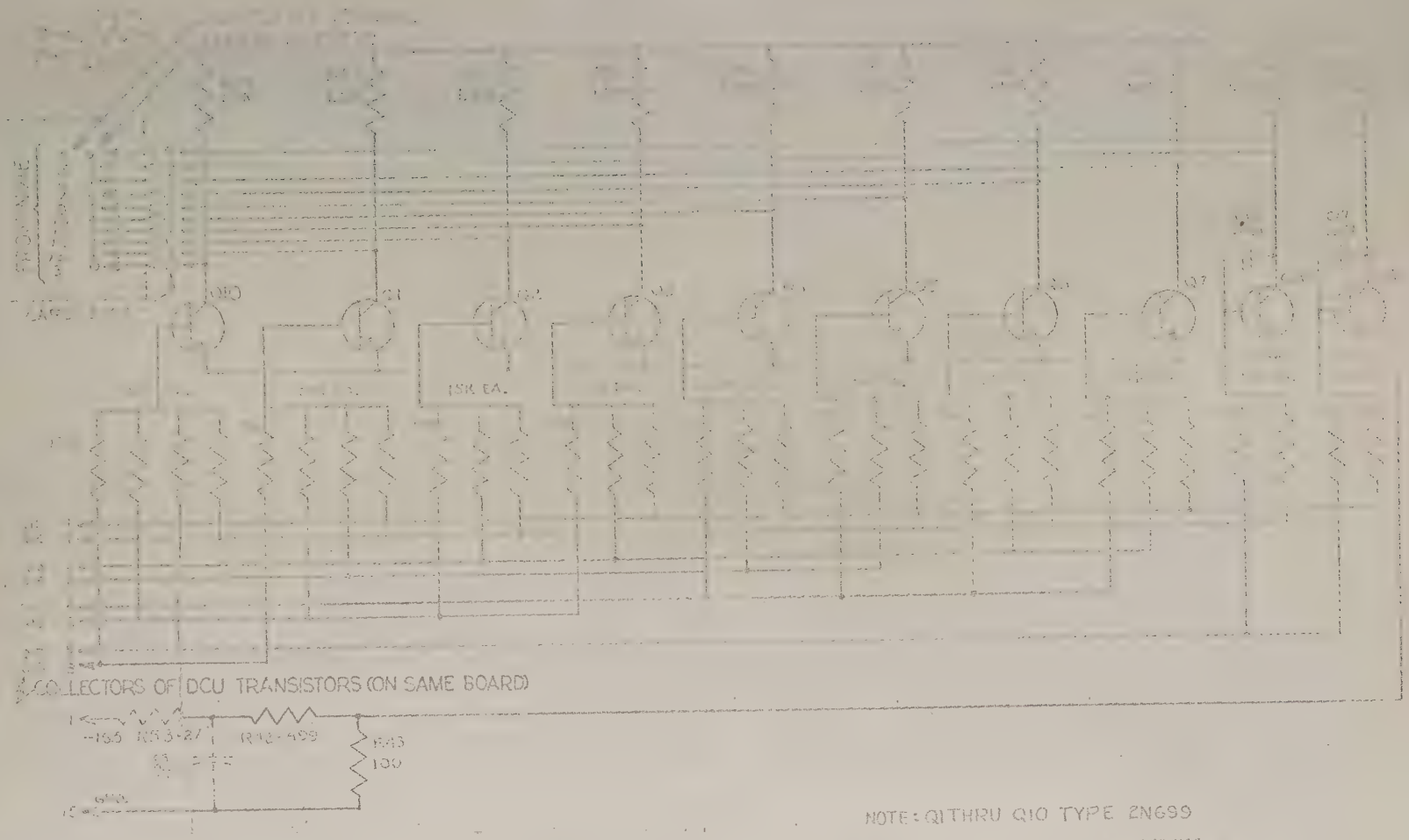
NOTE: QU THRU Q18 X
CRI TYPU C
C
BASE



NOTE: Q1 THRU Q6 ARE ...

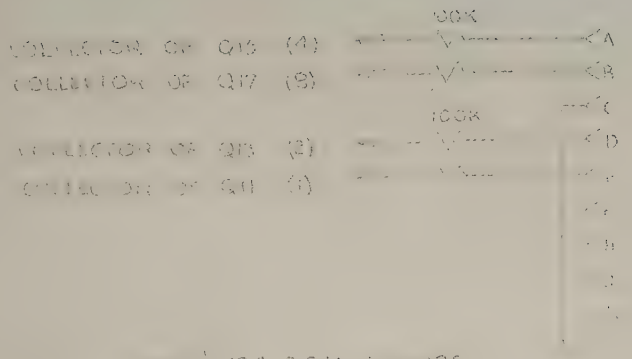
CONNECTOR NUMBERING

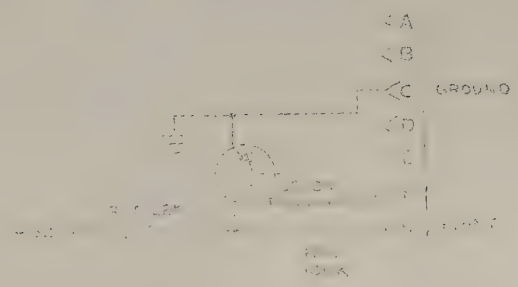
READOUT TUBE DRIVER CIRCUIT — PART OF TYPE 130 D.C.U. BOARDS — 3002

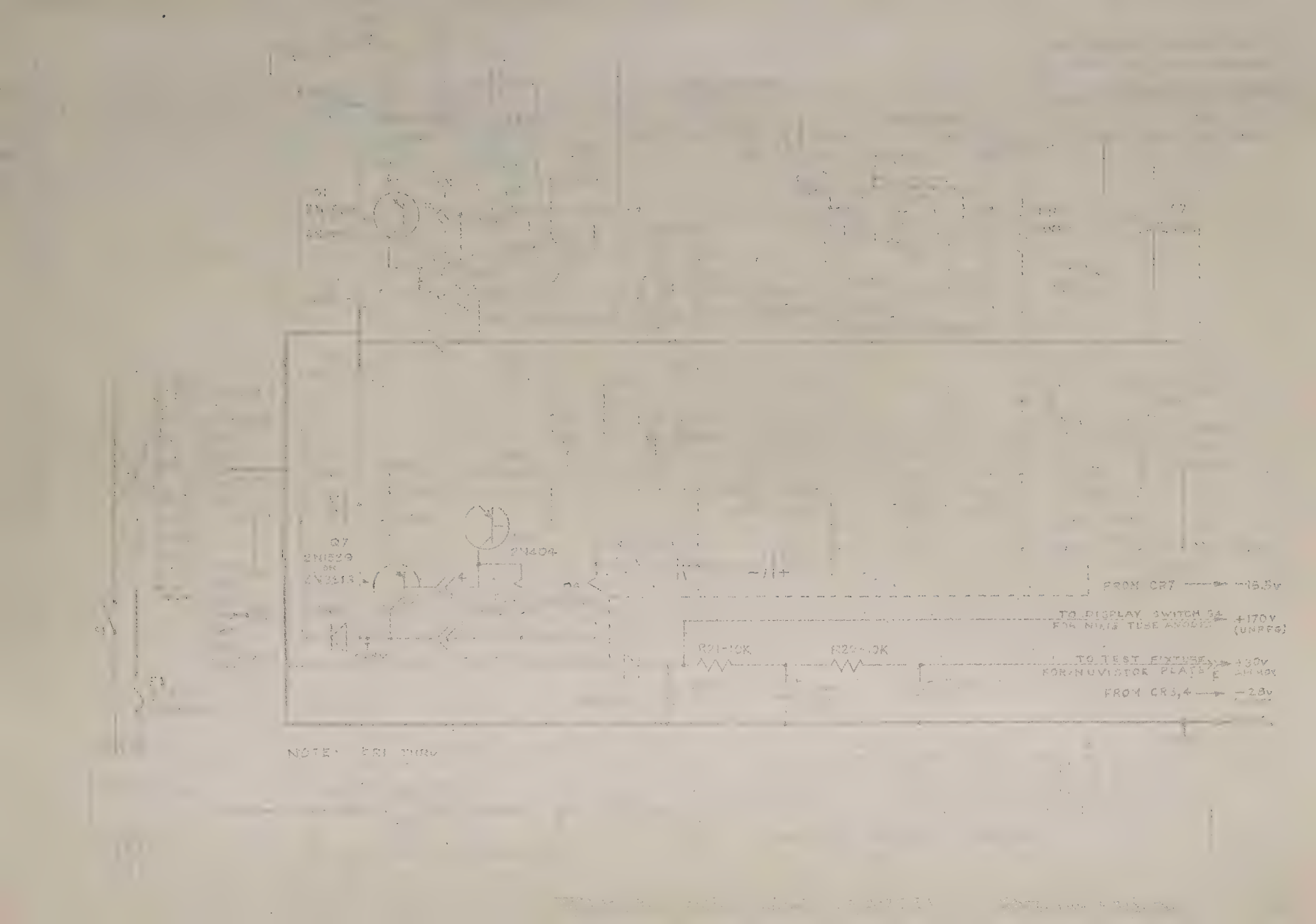


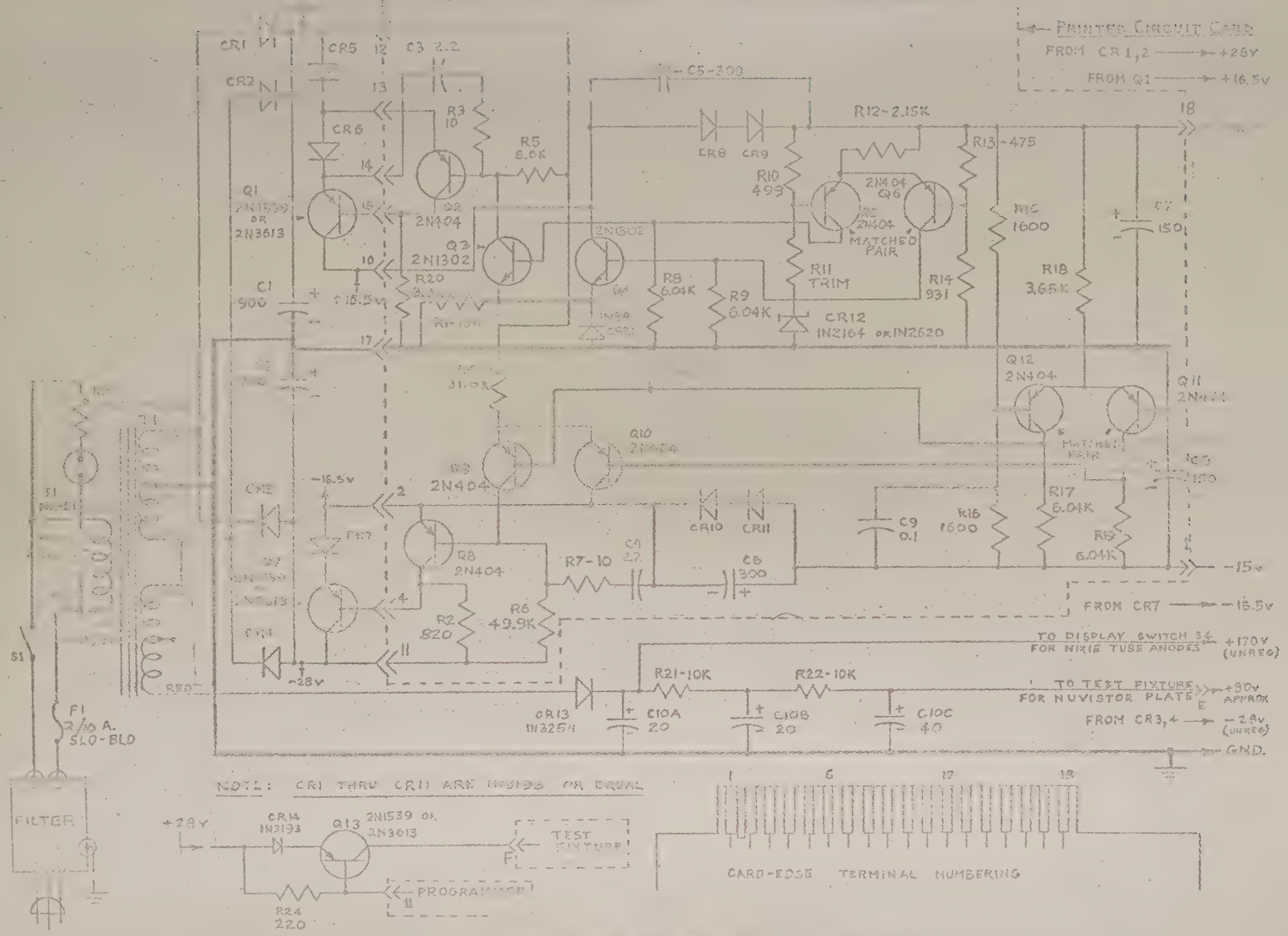
NOTE: Q1 THRU Q10 TYPE 2N699

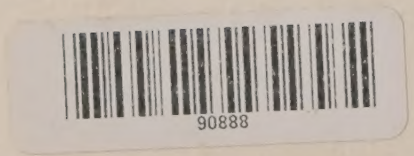
READOUT TUBE


+20V
+20V
A
B
C
D


A
B
C
GROUND
D


Q7
2N1529
OR
2N2613
2N1404
R21-10K
R22-10K
FROM CRT
TO DISPLAY SWITCH S4
FOR NIXIE TUBE ANODES
+170V
(UNREG)
TO TEST FIXTURE
FOR NUVISTOR PLATES
+30V
FROM CR3,4
-28V


PRINTER CIRCUIT CARD
FROM CR1,2 +28V
FROM Q1 +16.5V
CR1
CR2
CR5
C3 2.2
C5-300
R12-2.15K
R13-475
CR6
R3 10
R5 5.6K
CR8
CR9
R10 499
2N404 Q6
MATCHED PAIR
MIC 1600
C7 150
Q1 2N1539 OR 2N3613
Q2 2N404
Q3 2N1302
2N1302
R11 TRIM
R14 931
R18 3.65K
C1 900
+18.5V
R20 3.3K
R8 6.04K
R9 6.04K
CR12 IN2164 OR IN2620
IN34A CR21
Q12 2N404
Q11 2N404
MATCHED PAIR
31.6K
Q10 2N404
Q9 2N404
-16.5V
CR10
CR11
C9 0.1
R16 1600
R17 6.04K
R19 6.04K
-15V
CR7
Q8 2N404
R7-10
C4 2.2
C8 300
R2 820
R6 49.9K
FROM CR7 -16.5V
TO DISPLAY SWITCH 34 FOR NIXIE TUBE ANODES +170V (UNREG)
-28V
R21-10K
R22-10K
TO TEST FIXTURE FOR NUVISTOR PLATE +90V APPROX
CR13 IN3254
C10A 20
C10B 20
C10C 40
FROM CR3,4 -28V (UNREG)
GND.
S1
F1 2/10 A. SLO-BLO
FILTER
NOTE: CR1 THRU CR11 ARE IN198 OR EQUAL
+28V
CR14 IN3193
Q13 2N1539 OR 2N3613
TEST FIXTURE
R24 220
PROGRAMMER
1
6
12
18
CARD-EDGE TERMINAL NUMBERING
BOARD 1131 + CHASSIS


90888